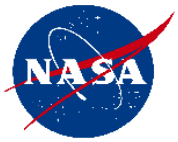

Centre National d'Etudes Spatiales

CALIPSO MISSION
SOFTWARE PROJECT MANAGEMENT PLAN

Document No. PC-PRJ-512 Revision - **1.3**

February 20, 2002

CALIPSO MISSION OFFICE
NASA LANGLEY RESEARCH CENTER
1 NORTH DRYDEN STREET
MAIL STOP 435
HAMPTON, VA 23681-2199

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Software Project Management Plan

PC-PRJ-512 Rev 1.3

PREPARED BY:

Name	Date	Signature
Robert Estes NASA LaRC Software Manager	2/27/02	Robert F. Estes

ACCEPTED BY:

Name	Date	Signature
John Stadler NASA LaRC Systems Engineer	2/27/02	
~~Jean Blouvac~~ Patrick CASTILLAN CNES Space Systems ~~Satellite Segment~~ Manager	3/7/02	
Victor Lucas NASA LaRC Ground Segment Manager	2/28/02	
Mary Beth Wusk GA Technical Software Mission Operations Manager	2/28/02	
Kim Cannon NASA LaRC Science Segment Manager	3/1/02	Kimberly A. Cannon
Leslie Johnson NASA LaRC Software Quality Assurance Manager	3/7/02	

APPROVED BY:

Name	Date	Signature
Dave Winker NASA LaRC Principal Investigator	3/7/02	
John Rogers NASA LaRC Project Manager	2/27/02	
Bruno Belon CNES Project Manager	3/7/02	

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REVISION LOG

Section No.	Revision Number	Reason for Change	Change Date	Approval
All	Draft	Initial Release	March 6, 2001	RFE
All	1.0	Incorporated review and restructuring comments	December 5, 2001	RFE
All	1.1	Partitioned NASA software into segments	January 2, 2002	RFE
All	1.2	Revised Launch Segment. Included acronyms, definitions, and terms appendices.	January 21, 2002	RFE
All	**1.3**	Removed Launch Segment from SPMP.	**February 20, 2002**	RFE

NOTE: The margins of this document are marked with a vertical black line to indicate where changes (additions, modifications, corrections, and deletions) from the previous issue were made.

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1. SCOPE

DOCUMENT IDENTIFICATION

The CALIPSO Software Project Management Plan (SPMP) identifies and establishes the philosophy and approach to be applied to software managed and developed by NASA and CNES within the auspices of the CALIPSO project. The CALIPSO SPMP further describes the lifecycle management approach to be applied to software developed or procured by NASA within the auspices of the CALIPSO project. The CALIPSO SPMP tailors generic software project management and product engineering guidelines to fit the needs of the CALIPSO project. This plan identifies policies, procedures, and guidelines used to facilitate the software engineering effort throughout the software development lifecycle.

DOCUMENT GOVERNANCE

The Langley Management System (LMS), ISO 9001 certified, provides a structure in which to perform project planning, beginning with the project plan checklist. The CALIPSO project plan checklist sponsors the creation of a SPMP tailored to fit the lifecycle needs of the CALIPSO project. This SPMP is written in accordance with LMS software engineering work instructions and guidelines.

The CALIPSO SPMP applies to the management of the software interfaces between NASA and CNES developed Computer Software Configuration Items (CSCIs) intended for delivery as a flight system, ground system, or test equipment or to be used in conjunction with formal qualification testing. Section 4 identifies the CSCI interfaces that are applicable to this management plan.

The CALIPSO SPMP applies to software developed or acquired by NASA intended for delivery as a flight system, ground system, or test equipment or to be used in conjunction with formal qualification testing. Section 4 identifies the CSCIs that are to be governed by this management plan.

PROJECT OVERVIEW

The following terms, see Figure 1 CALIPSO Satellite, will be commonly be used:

Payload : The integrated instrument suite and other payload subsystems (Lidar, IIR, WFC, Payload Controller, Solid State Recorder, X-Band Downlink System, and Payload structure). The star trackers, a spacecraft subsystem, will also be physically mounted on the Payload.

Platform : The spacecraft bus to which the Payload is attached.

Satellite : The integrated Platform and Payload.

CALIPSO will fly a suite of a single active and two passive sensors in formation with the Earth Observing System Aqua, previously Post-Meridian (PM), satellite to provide continuous, near-simultaneous measurements for a period of 3 years. The spacecraft, provided by CNES, will be operated by CNES throughout the life of the mission. The Payload will be commanded and controlled by the Langley Research Center (LaRC) Payload Operations and Control Center (POCC), uplinking Payload commands through the CNES Spacecraft Operations Control Center (SOCC). Payload data will be downlinked to a commercial ground station and delivered to LaRC for storage, processing, and distribution. See Figure 2 CALIPSO Mission Architecture. The CALIPSO satellite will be co-manifested with the CloudSat satellite on a standard Boeing Delta II 7420-10 launch vehicle equipped with a standard Delta II composite fairing, standard height Dual Payload Attach Fitting (DPAF), and a 37C Payload Attach Fitting (PAF). The CALIPSO satellite will occupy the upper berth of the DPAF with CloudSat satellite in the lower berth. The satellites will be launched from the Vandenberg Air Force Base (VAFB) Launch Facility in California.

The payload consists of a lidar, a visible wide field camera (WFC), and an imaging infrared radiometer (IIR). The lidar acquires vertical profiles of backscatter at 532 nm and 1064 nm from a near nadir viewing geometry during day and night segments of the orbit. Two orthogonal polarization components are measured at 532 nm. The lidar profiles provide information on the vertical distribution of aerosols and clouds, cloud particle phase, and classification of aerosol size. The IIR provides medium spatial resolution nadir viewing images at 8.7, 10.5, and 12.0 mm. The IIR operates continuously, day and night, providing information on cirrus cloud particle size and infrared emissivity. The WFC collects high spatial resolution imagery in the 620 - 670 nm wavelength range during the daylight segments of orbit. The WFC is used to ascertain cloud homogeneity over the lidar footprint, aid in cloud clearing, and to provide meteorological context.

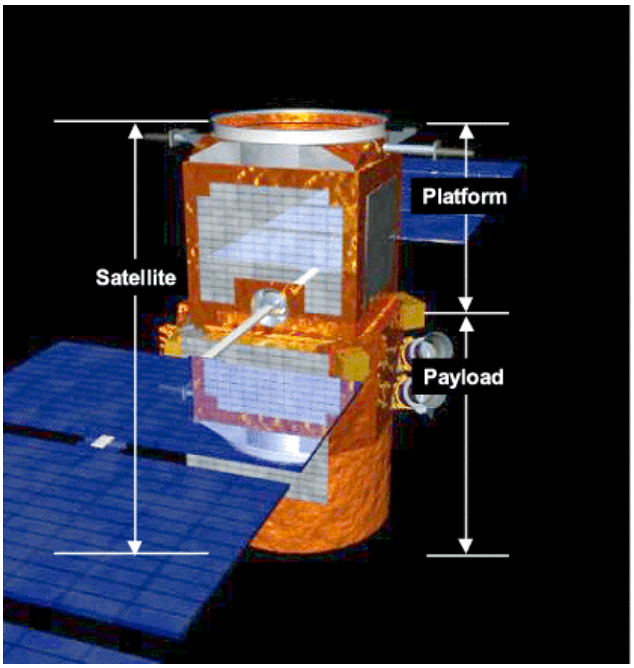

Figure 1 CALIPSO Satellite

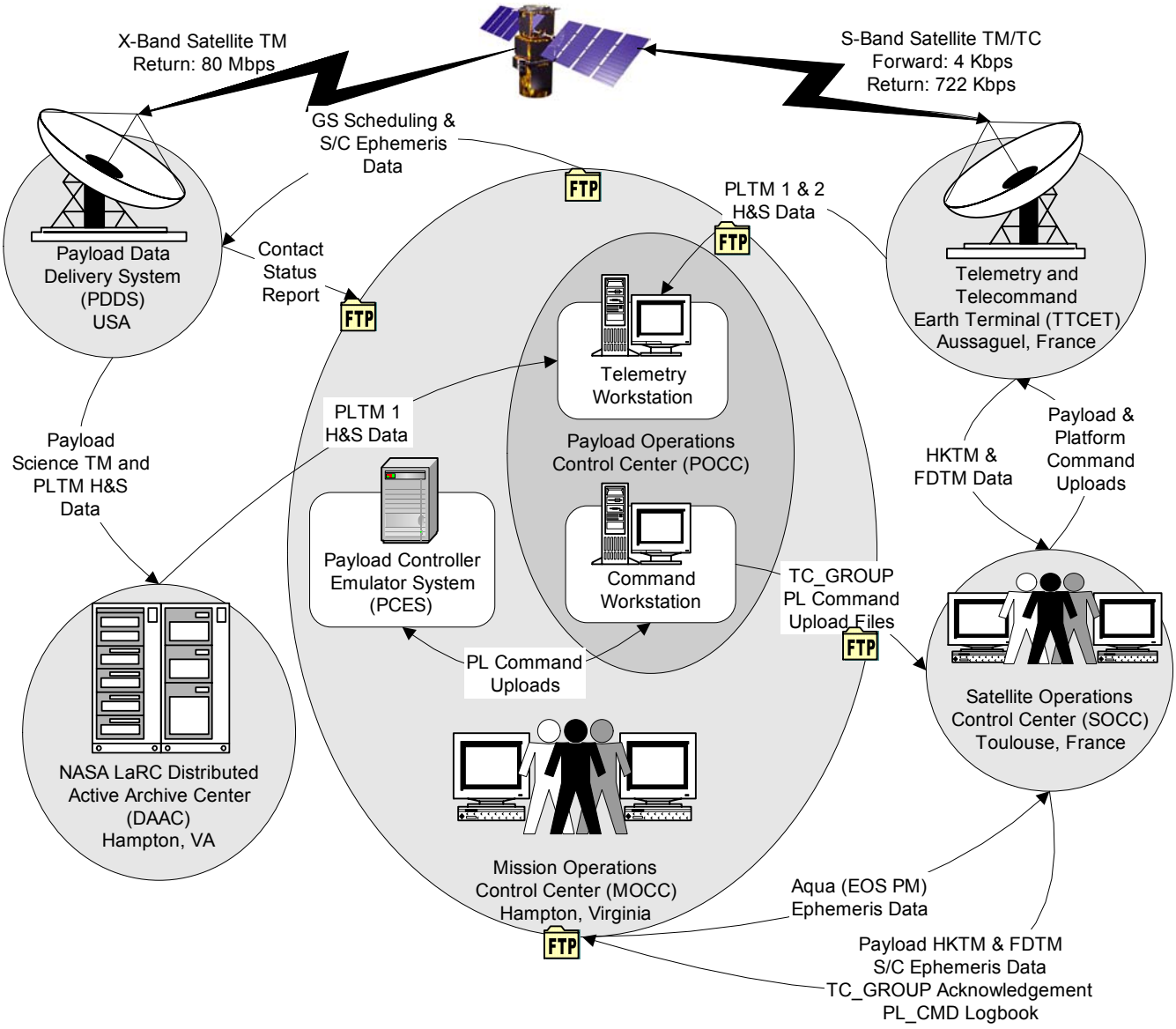

Figure 2 CALIPSO Mission Architecture

EVOLUTION OF THE SPMP

The CALIPSO SPMP will be baselined after the CALIPSO Mission Confirmation Review (MCR) and will be maintained under configuration control in accordance with the CALIPSO Configuration Management Plan (CMP).

DOCUMENT ORGANIZATION

This SPMP is organized as follows:

- Section 1 identifies the SPMP, discusses its scope, and describes briefly the CALIPSO project.
- Section 2 identifies the documents referenced in the SPMP.
- Section 3 provides an overview of the software, organization, and roles and responsibilities within the CALIPSO project.
- Section 4 defines the plans for managing software spanning the CALIPSO project.
- Appendix A details the metrics to be collected for each software development.

2. APPLICABLE DOCUMENTS

The following documentation has bearing on the development of various CALIPSO software configuration items. Unless a specific issue or revision is listed, the referenced documents shall be of that issue or revision in effect on the date of release of this SPMP.

GOVERNING DOCUMENTS

DOCUMENT NUMBER	REVISION		DOCUMENT TITLE	DATE
	VER	REL		
NASA/CNES MOU	--	--	NASA/CNES Memorandum of Understanding (MOU)	--
PC-AGR-504	0.0	1.0	NASA/CNES Project Plan	28 Feb 2001
PC-SYS-101	1.3	--	Science & Mission Requirements Document (SMRD)	18 May 2000
PC-SYS-301	--	--	Mission Integration, Test and Verification Plan	--
PC-PRJ-503	1.0	1.0	Mission Assurance Management Plan	28 Feb 2001
PC-PRJ-505	1.1	2.0	Safety Management Plan	1 Oct 2001
PC-PRJ-504	--	--	Continuous Risk Management Plan	Mar 2001
PC-PRJ-509	1.0	--	Configuration Management Plan	25 Sep 2001
PC-PRJ-513	0.1	--	Software Quality Assurance Management Plan	5 Jan 2001

Table 1 Governing Documents

OTHER DOCUMENTS

DOCUMENT NUMBER	REVISION		DOCUMENT TITLE	DATE
	VER	REL		
PC-SYS-103	--	--	Mission Operations Concept Document	Nov 2000
PC-GND-501	0.1	--	CALIPSO MOCC Workstation and Servers Software Development And Management Plan	27 Nov 2001
PC-PRJ-517	--	--	CALIPSO Science Data Processing Software Management Plan	Jan 2002
PC-AGR-801	--	--	CALIPSO Project/Software IV&V Facility Memorandum of Agreement (MOA)	25 Sep 2001

Table 2 Other Documents

INTERFACE DOCUMENTS

DOCUMENT NUMBER	REVISION		DOCUMENT TITLE	DATE
	VER	REL		
PC-SYS-102	1.0	--	Segment Requirements Document (SRD)	19 Sep 2000
PIC-LB-SP-202-CNES	2.0	0	Satellite Segment Specification	20 Feb 2001
PIC-LB-SP-203-CNES	4.0	0	Payload Design and Interface Specification (PDIS)	19 Sep 2001
PC-PLD-201	1.3	0	PICASSO-CENA Payload Description Document	5 Jul 2000
CNES 99/NT98/DTS/AE/INS/IO	2.0	0	Imaging Infrared Radiometer Specification	18 May 2000
PC-PLD-902	--	--	IIR ICD	--
PIC-P0-SP-201-CNES	2.0	2.0	P-C Mission Spec Satellite to Ground Interface Specification	29 Jan 2001
PIC-P0-0-SP-220-CNES	1.0	0	ESSP3-CENA MOGS-SOGS Interface Control Document	22 Oct 2001

Table 3 Interface Documents

REFERENCE DOCUMENTATION

DOCUMENT NUMBER	REVISION		DOCUMENT TITLE	DATE
	VER	REL		
MIL-STD_1553B	Notice 2	--	Aircraft Internal Time Division Command/Response Multiplex Data Bus	09/08/86
TBR Edition 3	0	--	Proteus User's Manual	--
SEL-81-305	3	--	Recommended Approach to Software Development	June, 1992
ANSI/IEEE Std 1008-1987	--	--	IEEE Standard for Software Unit Testing	1987
IEEE Std 1012-1998	--	--	IEEE Standard for Software Verification and Validation	1998
IEEE Std 1016-1998	--	--	IEEE Recommended Practice for Software Design Descriptions	1998
IEEE Std 1028-1997	--	--	IEEE Standard for Software Reviews	1998
IEEE Std 1058-1998	--	--	IEEE Standard for Software Project Management Plans	1998
IEEE Std 1059-1993	--	--	IEEE Guide for Software Verification and Validation Plans	1993
IEEE Std 1062-1998	--	--	IEEE Recommended Practice for Software Acquisition	1998
IEEE Std 1063-1987	--	--	IEEE Standard for Software User Documentation	1987
IEEE Std 1219-1998	--	--	IEEE Standard for Software Maintenance	1998
IEEE Std 1228-1994	--	--	IEEE Standard for Software Safety Plans	1994
IEEE Std 1233-1998	--	--	IEEE Guide for Developing System Requirements Specifications	1998
IEEE Std 1362-1998	--	--	IEEE Guide for Information Technology - System Definition - Concept of Operations (ConOps) Document	1998
IEEE Std 1545-1999	--	--	IEEE Standard for Parametric Data Log Format	1999
IEEE Std 610.12-1990	--	--	IEEE Standard Glossary of Software Engineering Terminology	1990
IEEE Std 730-1998	--	--	IEEE Standard for Software Quality Assurance Plans	1998
IEEE Std 828-1998	--	--	IEEE Standard for Software Configuration Management Plans	1998
IEEE Std 829-1998	--	--	IEEE Standard for Software Test Documentation	1998
IEEE Std 830-1998	--	--	IEEE Recommended Practice for Software Requirements Specifications	1998
IEEE/EIA 12207.0-1996	--	--	IEEE/EIA Standard for Information Technology - Software life cycle processes	1996
IEEE/EIA 12207.1-1997	--	--	IEEE/EIA Standard for Information Technology - Software life cycle processes - Life cycle data	1997
IEEE/EIA 12207.2-1997	--	--	IEEE/EIA Standard for Information Technology - Software life cycle processes - Implementation considerations	1997
LMS-CP-5528	B	--	Software Planning, Development, Acquisition, Maintenance, And Operations	06/20/00
LMS-CP-5529	B	--	Software Configuration Management Planning for Low-, High-, and Critical-Control Software	01/19/00
LMS-CP-5532	B	--	Software Acquisition Planning	06/20/00
LMS-CP-5525	A	--	Distributed Active Archive Center (DAAC) Project Management	08/01/99
LMS-CP-1380	A	--	Science Satellite Mission Operations	07/12/99

Table 4 Reference Documentation

3. SOFTWARE OVERVIEW

SCOPE

The NASA/CNES Memorandum Of Understanding (MOU) is the driving directive in the management of the CALIPSO mission between NASA and CNES. The MOU states that each government organization agrees to be responsible for their contributed mission elements. This SPMP describes the framework within which each organization will develop, deliver, and support CALIPSO project software. Using the NASA/CNES MOU as a guiding framework, NASA and CNES will use their own internal processes and standards in production of software for the CALIPSO project. NASA will control software management using NASA standard practices and procedures as identified within this SPMP. CNES will control software management using CNES standard practices and procedures.

All interfaces between mission products (segments, systems, and Computer Software Configuration Items (CSCIs)) are defined in Interface Control Documents (ICDs). These ICDs will define the interface, designate responsibility for each aspect of the interface, as well as, designate responsibility and authority for resolving changes and issues with each interface. The ICDs will be placed under configuration control after they have been developed by the appropriate project personnel and approved by project management. Changes to an ICD will use the configuration change control process contained in the CALIPSO CMP (PC-PRJ-509).

CNES provided software systems and their development will be governed by the **CNES Provided Software** paragraph of this SPMP. The remaining SPMP sections will not be applicable to CNES provided software systems or their development.

NASA provided software systems and their development will be governed by the **NASA Provided Software** paragraph of this SPMP.

ORGANIZATION

At the mission level, the NASA and CNES segment managers in accordance with the mission I&T manager and the software manager will jointly participate in planning and coordinating software and interface validation activities to ensure the development of the systems and software required to support the needs of the mission. The mission software manager is also responsible for ensuring frequent interaction between software, electronics, and operations disciplines.

The primary responsibilities of CALIPSO software manager are to provide oversight and guidance for CALIPSO software system planning, development, organization, monitoring, control, and reporting. The CALIPSO software manager will ensure that all software development meets requirements, is delivered on time, and within budget. The CALIPSO software manager shall provide a monthly report of software development activities, status, accomplishments, and risks to the CALIPSO systems engineer and project manager. Software Quality Assurance (SQA) is performed in accordance with the CALIPSO SQA Management Plan. The Software Independent Verification and Validation (IV&V) is performed by the NASA Goddard Space Flight Center (GSFC) Software IV&V Facility in accordance with the CALIPSO Project/Software IV&V Facility Memorandum of Agreement (MOA).

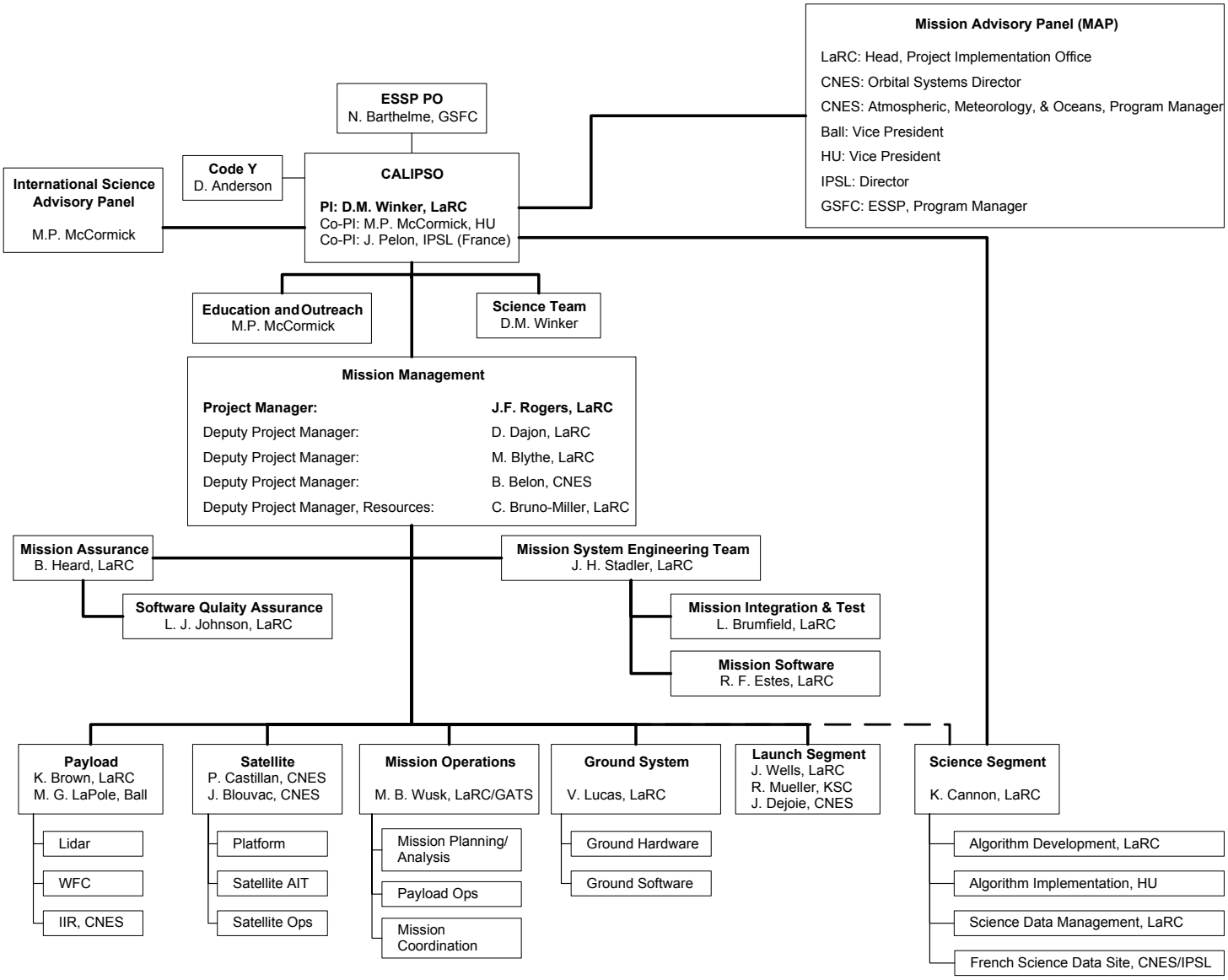

Figure 3 CALIPSO Mission Organization

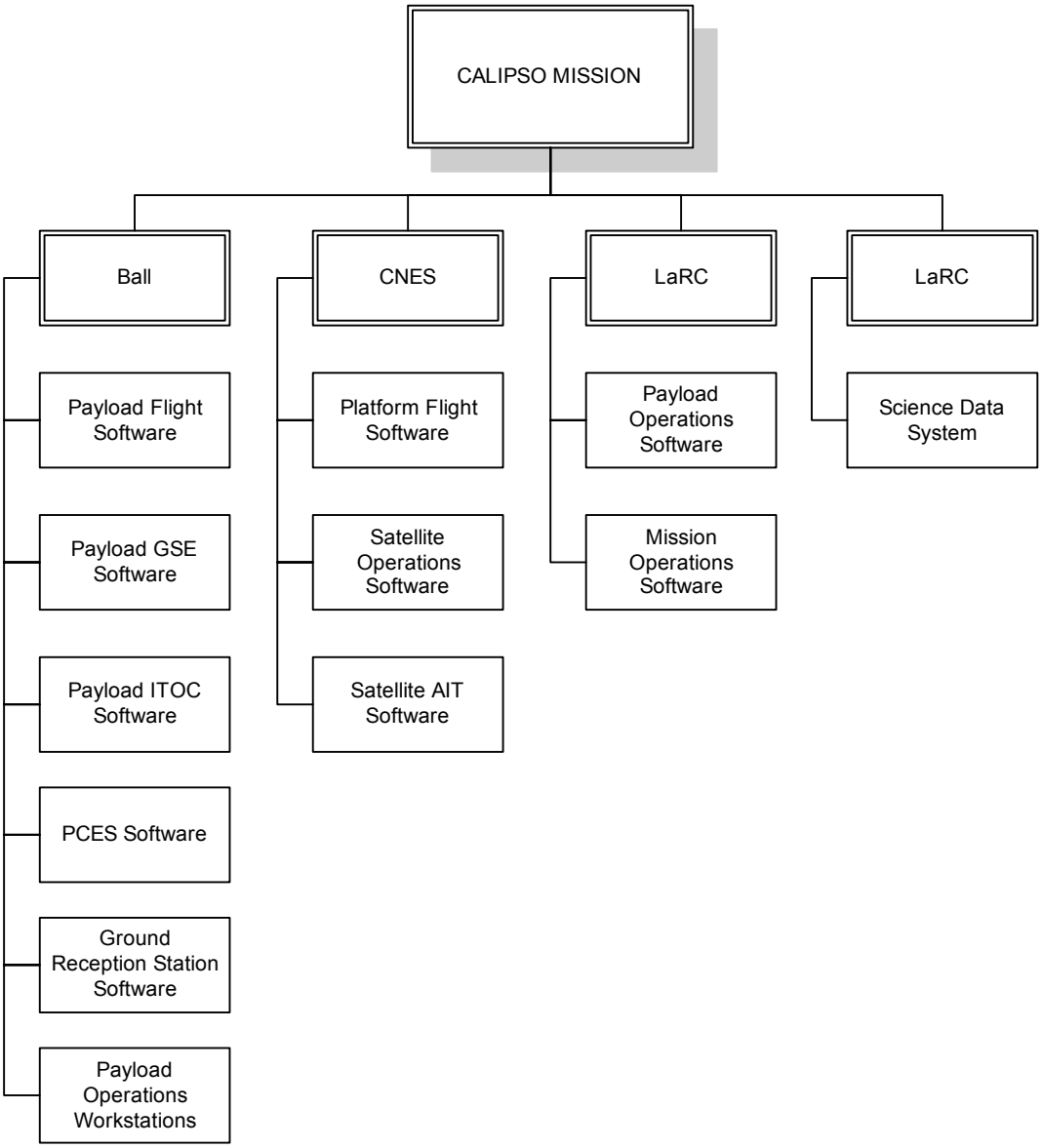

Figure 4 CALIPSO Software System Partitioning

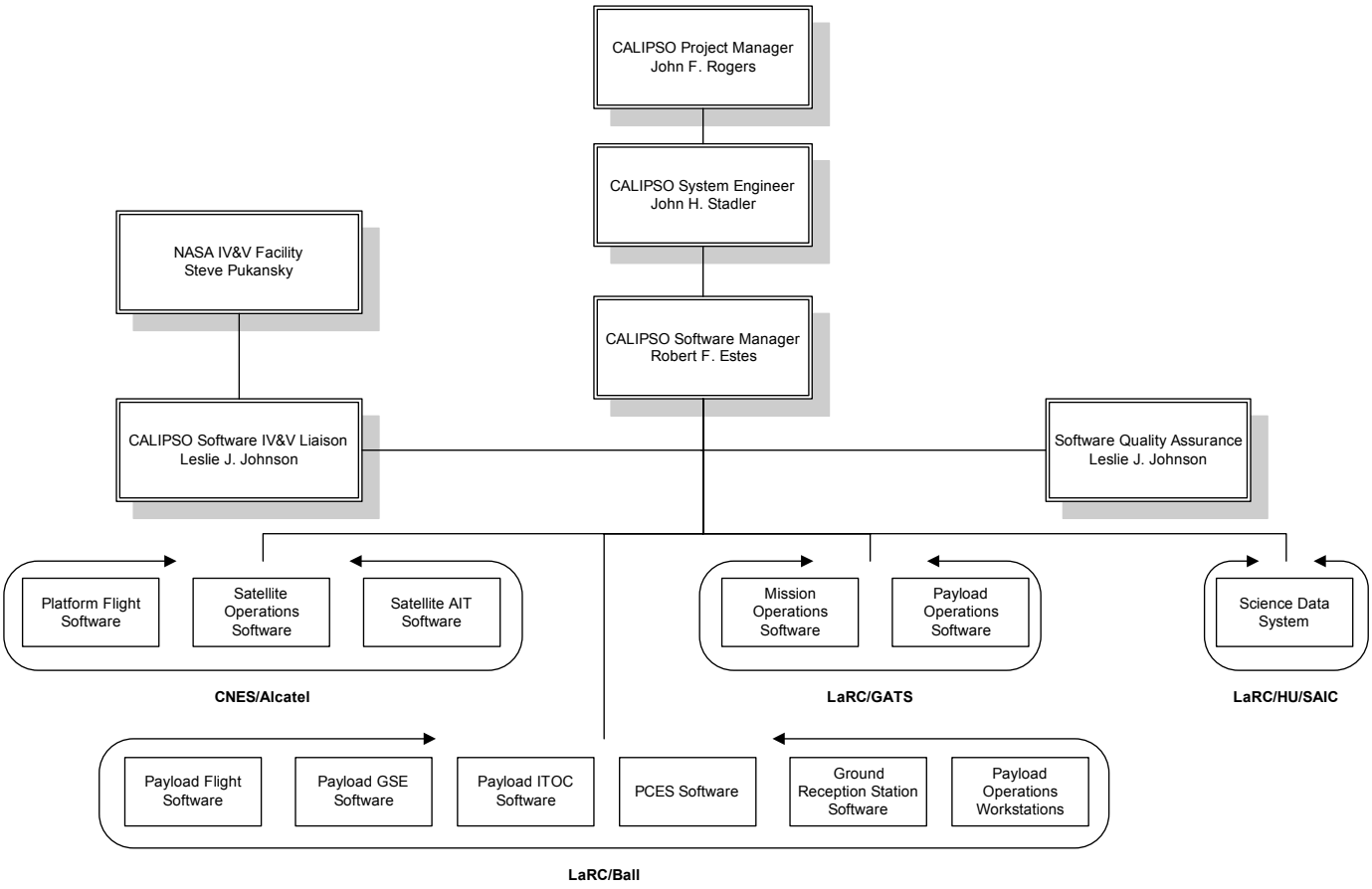

Figure 5 CALIPSO Software Organization

RESPONSIBILITY

The CALIPSO project is composed of NASA LaRC, BATC, CNES (Centre National D'Etudes Spatiales), Institue Pierre Simon LaPlace (IPSL). The following paragraphs summarize each agency's responsibilities.

BATC Aerospace & Technologies Corp. Aerospace Systems Division

BATC will provide the Payload, including the LIDAR, WFC, and other Payload support systems. BATC will assist Alcatel with the Payload-to-Spacecraft integration and test. BATC will provide the Payload Data Delivery System. BATC will provide the system for Payload operations in the POCC at LaRC, and will train LaRC personnel who will be staffing the POCC during the On Orbit Phase. BATC will assist with initial On-Orbit Checkout and Validation and Anomaly Resolution activities. BATC will provide assistance with launch vehicle integration at the launch site. BATC will provide sustaining engineering and maintenance for all software deliverables for the duration of the CALIPSO mission.

NASA Langley Research Center (LaRC)

NASA LaRC has the overall mission management responsibility. LaRC will be responsible for mission leadership, program management, system engineering, mission operations, payload operations, mission validation, payload validation, science data processing, archival, and launch vehicle integration.

Centre National D'Etudes Spatiales (France)

CNES will provide the PROTEUS (Plateforme Reconfigurable pour l'Observation, les Telecommunications, et les Usages Scientifiques) platform, the IIR sensor, Payload-to-Platform integration, platform engineering, and platform mission operations.

Institut Pierre Simon Laplace (IPSL)

IPSL will provide the IIR science data processing algorithms, IIR validation, and the French data system.

SCHEDULE

The CALIPSO Segment Managers will develop and maintain a schedule for their assigned segment. Software schedules will be identified at the appropriate segment, system, or subsystem level within the CALIPSO segment schedules. Software schedules will include, but not be limited to the following information:

- Major software developmental milestones for each CSCI
- All CSCI integration and test activities
- All CSCI major software reviews
- All software schedule dependencies
- All major CALIPSO reviews
- All major CALIPSO milestones
- High level milestones and events of hardware dependencies

The CALIPSO Mission Segment schedules will be developed and maintained by the CALIPSO segment managers, who will ensure it is consistent with the CALIPSO Integrated Master Schedule which is under the control of the CALIPSO Configuration Control Board. The Integrated segment schedules will be configuration controlled in accordance with the CALIPSO CMP. The Master and Segment schedules will be reviewed monthly with all providers, as well as with project engineering.

4. SOFTWARE MANAGEMENT

Given the number of geographically dispersed and dependent software developments embodying the CNES and NASA contributed software and systems for the CALIPSO mission, it is important that there be rigor, flexibility, and consistency in their development and management. This section describes the approaches defined by the CALIPSO project for the comprehensive management of these diverse CNES and NASA contributed software developments.

CNES PROVIDED SOFTWARE

Management

CALIPSO Mission software systems will be mutually developed as specified within the NASA/CNES CALIPSO Project Plan, PC-AGR-504. The project plan is a mutual NASA/CNES plan for developing the systems and software which support the ground system, satellite, launch, operations and science segments for the CALIPSO Mission. CNES provided CSCIs are identified in Table 5 CNES Contributed Software. The project plan defines how this cooperative project will be implemented, including:

- mission management (responsibilities, reviews, configuration control, documentation, actions management, confidentiality, schedule management),

- reciprocal products deliveries and management of their interfaces (launcher, satellite, payload, instruments, ground systems),
- mission operations (responsibilities, data deliveries),
- and other such information as the NASA Project Manager and CNES Deputy Project Manager deem necessary for project control.

Software System	Provider
Platform Flight Software	CNES / Alcatel
Satellite AIT Software	CNES / Alcatel
SOGS Software	CNES

Table 5 CNES Contributed Software

Reporting

CNES will provide information supporting LaRC's responsibility to generate a monthly report for the ESSP Mission Manager. The CALIPSO software manager will review this information with respect to software, systems, and interfaces and prepare a monthly software report for the CALIPSO project management. CALIPSO project management will incorporate applicable information into the report generated for the ESSP mission manager. LaRC will provide this project report to CNES for information.

CNES will discuss CNES provided software status, technical details and issues at mission milestone reviews.

Communications

Effective communications between CNES and NASA is vital to mission success. The following methods will be utilized to ensure appropriate and timely interchange.

- Technical Representatives from CNES, LaRC on-site at each other's facilities
- Teleconferences (weekly, monthly, as needed)
- Monitoring/Reporting (weekly, monthly, as needed)
- Focused Technical Interface Meetings (face-to-face) with partners on a regular basis and in combination with other reviews when possible
- Reviews
- E-mail
- Documentation: Formal & Informal
- Livelink server for various functions:
    - Document Library
    - Project Status
    - News
    - User's Subprojects
    - Threaded Discussions
- Project Calendars
- Videoconferences (as needed)

NASA PROVIDED SOFTWARE

Software acquired or developed by NASA for the CALIPSO mission are within the scope of this SPMP. The CALIPSO Software Project Management Plan applies to software intended for delivery as a flight system, ground system, or test equipment or to be used in conjunction with formal qualification testing.

NASA contributed software will be conducted in accordance with a software project management plan (SPMP) or SAP written by the developing organization and approved by the CALIPSO Project. The SPMPs will be documented following the guidance provided in IEEE Standard 1058-1998, *IEEE Standard for Software Project Management Plans.* The SPMP will explicitly identify the CSCIs to be provided by the developer.

NASA contributed software and systems for the CALIPSO mission shall be LMS compliant. See Table 4 Reference Documentation for applicable LMS procedures. Developers will find assistance in planning their development documented in NASA's *Recommended Approach to Software Development.* This assistance includes guidance for document and review contents.

NASA contributed software systems will be managed and implemented as specified within the system's SPMP or Software Acquisition Plan (SAP). These plans are a mutual plan between NASA and the system developer for the systems and software which support the ground system, satellite, launch, operations and science segments of the CALIPSO Mission. NASA provided CSCIs are identified in Table 6 NASA Contributed Software. The makeup and staffing of each software development organization will be identified in the SPMP or SAP of each software provider where, the scope of the software effort is also quantified.

Each SPMP defines how this cooperative project will be implemented, including:

- system management (responsibilities, reviews, configuration control, documentation, actions management, confidentiality, schedule management),
- reciprocal products deliveries and management of their interfaces (launcher, satellite, payload, instruments, ground systems),
- mission operations (responsibilities, data deliveries),
- and other such information as necessary for project control.

Software Quality Assurance

Overall CALIPSO project Software Quality Assurance (SQA) will be managed by the LaRC Office of Safety and Mission Assurance (OSMA). The SQA approach is documented in the CALIPSO SQA Management Plan.

Software IV&V

The CALIPSO Project has negotiated a Memorandum of Agreement (MOA) with the NASA Software Independent Verification and Validation (IV&V) Facility for the performance of Software IV&V on the CALIPSO Project. The MOA documents the working relationship, roles and responsibilities, and points of contact necessary to assure mutual benefits to the parties involved.

Software System	Provider
Payload Flight Software	LaRC / BATC
Payload GSE Software	LaRC / BATC
PCES Software	LaRC / BATC
Payload Command & Telemetry Workstation Software	LaRC / BATC
POCC Software	LaRC / GATS
MOCC Software	LaRC / GATS
Science Data System Software	LaRC / HU / SAIC

Table 6 NASA Contributed Software

LaRC/BATC

Management

All BATC software developed and delivered to the CALIPSO Project under contract number NAS1-99135 will be managed and implemented as specified in the BATC SPMP, Software Management Plan For PICASSO-CENA, SER-SYS-2310.

Communications

The following methods will be utilized to ensure appropriate and timely interchange between the CALIPSO project and BATC software development.

- Technical Representatives from developing organizations and LaRC on-site at each other's facilities
- Teleconferences (weekly, monthly, as needed)
- Monitoring/Reporting (weekly, monthly, as needed)
- Focused Technical Interface Meetings (face-to-face) with partners on a regular basis and in combination with other reviews when possible
- Reviews
- E-mail
- Documentation: Formal & Informal
- Livelink server for various functions:
    - Document Library
    - Project Status
    - News
    - User's Subprojects
    - Threaded Discussions
- Project Calendars
- Videoconferences (as needed)

Weekly Status Meeting

The CALIPSO software manager will conduct a weekly teleconference with the participation of the BATC software manager and software engineers. The purpose of this teleconference is to ensure coordination and timely resolution of issues.

Schedules and Milestones

BATC shall deliver a monthly project schedule and logic network report to CALIPSO project management 10 working days after the close of the BATC accounting month as described in DRD-3 of the BATC Statement of Work (SOW).

Progress Metrics

BATC shall deliver a monthly project progress report to CALIPSO project management 10 working days after the close of the BATC accounting month as described DRD-2 of the BATC SOW.

Control Boards and Working Groups

As required, various software specific boards and working groups will be formed with affected members of the CALIPSO software and systems community, as well as interfacing organizations. The BATC software manager and appropriate software engineers will participate as members of the following CALIPSO project control boards and integrated teams:

- CALIPSO Configuration Control Board (CCCB)
- Mission Integrated Team (MIT)
- Satellite Integrated Team (SIT)

Documentation Requirements

BATC will document software products and software engineering activities as identified within the BATC SOW and described within the BATC SPMP.

Reviews/Audits/Inspections

BATC will conduct reviews, audits, and inspections as identified within the BATC SOW and described within the BATC SPMP.

Peer Reviews

BATC will conduct software peer reviews as identified within the BATC SOW and described within the BATC SPMP.

Formal Reviews

BATC will conduct software formal reviews as identified within the BATC SOW and described within the BATC SPMP.

Integration and Test

BATC will conduct software integration and test as identified within the BATC SOW and described within the BATC SPMP.

Acceptance

BATC will conduct software acceptance as identified within the BATC SOW and described within the BATC SPMP.

Standards, Practices, and Conventions

BATC will use the standards, practices, and procedures identified within the BATC SOW and described within the BATC SPMP and other applicable engineering documents.

Configuration Management

Configuration Management (CM) of all software artifacts (i.e., documentation, operational software, support software, scripts, procedures, data, etc.) will be the responsibility of BATC until delivered to the CALIPSO project for baselining in the case of documentation, or for integration in the case of software. Software configuration management is described within the BATC SPMP. After the CALIPSO project assumes configuration management of a software artifact, BATC will be responsible for all submissions and updates of the artifact through the CALIPSO project CM system in accordance with the CALIPSO Configuration Management Plan, PC-PRJ-509.

Risk Management

BATC will conduct software risk management as identified within the BATC SOW and described within the BATC SPMP.

Quality Assurance

BATC will conduct software quality assurance management as identified within the BATC SOW and described within the BATC SPMP and Software Quality Assurance Plan (SQAP) in accordance with CALIPSO SQA management plan.

LaRC/GATS

Management

All GATS software developed and delivered to the CALIPSO Project will be managed and implemented as specified in the GATS SPMP, CALIPSO MOCC Workstation and Servers Software Development And Management Plan, PC-GND-501.

Communications

The primary method of communication between the GATS software manager and the CALIPSO software manager will be frequent informal meetings and discussions in addition to the weekly status meeting described below. The following methods may also be utilized to ensure appropriate and timely interchange between the CALIPSO project and GATS software development.

- Technical Representatives from developing organizations on-site at LaRC facilities
- Teleconferences (weekly, monthly, as needed)
- Monitoring/Reporting (weekly, monthly, as needed)
- Focused Technical Interface Meetings (face-to-face) with partners on a regular basis and in combination with other reviews when possible
- Reviews
- E-mail
- Documentation: Formal & Informal
- Livelink server for various functions:
    - Document Library
    - Project Status
    - News
    - User's Subprojects
    - Threaded Discussions
- Project Calendars
- Videoconferences (as needed)

Weekly Status Meeting

The CALIPSO software manager will conduct a weekly teleconference with the participation of the GATS software manager and software engineers. The purpose of this teleconference is to ensure coordination and timely resolution of issues.

Schedules and Milestones

GATS shall deliver a monthly project schedule and logic network report to CALIPSO ground segment and project management.

Progress Metrics

GATS shall deliver a monthly project progress report to CALIPSO ground segment and project management.

Control Boards and Working Groups

As required, various software specific boards and working groups will be formed with affected members of the CALIPSO software and systems community, as well as interfacing organizations. The GATS software manager and appropriate software engineers will participate as members of the following CALIPSO project control boards and integrated teams:

- CALIPSO Configuration Control Board (CCCB)
- Mission Integrated Team (MIT)
- Satellite Integrated Team (SIT)

Documentation Requirements

GATS will document software products and software engineering activities as identified and described within the GATS SPMP.

Reviews/Audits/Inspections

GATS will conduct reviews, audits, and inspections as identified and described within the GATS SPMP.

Peer Reviews

GATS will conduct software peer reviews as identified and described within the GATS SPMP.

Formal Reviews

GATS will conduct software formal reviews as identified and described within the GATS SPMP.

Integration and Test

GATS will conduct software integration and test as identified and described within the GATS SPMP.

Acceptance

GATS will conduct software acceptance as identified and described within the GATS SPMP.

Standards, Practices, and Conventions

GATS will use the standards, practices, and procedures identified and described within the GATS SPMP and other applicable engineering documents.

Configuration Management

Configuration Management (CM) of all software artifacts (i.e., documentation, operational software, support software, scripts, procedures, data, etc.) will be the responsibility of GATS until delivered to the CALIPSO project for baselining in the case of documentation, or for integration in the case of software. Software configuration management is described within the GATS SPMP. After the CALIPSO project assumes configuration management of a software artifact, GATS will be responsible for all submissions and updates of the artifact through the CALIPSO project CM system in accordance with the CALIPSO Configuration Management Plan, PC-PRJ-509.

Risk Management

GATS will conduct software risk management as identified within the GATS SOW and described within the GATS SPMP.

Quality Assurance

GATS will conduct software quality assurance management as identified within the GATS SOW and described within the GATS SPMP in accordance with CALIPSO SQA management plan.

Science Segment

Management

All CALIPSO science segment software will be managed and implemented as specified in the science data system SPMP, CALIPSO Science Data Processing Software Management Plan, PC-PRJ-517.

Communications

The science segment manager will act as the science segment software interface to the CALIPSO Project. The primary method of communication between the science segment manager and the CALIPSO software manager will be frequent informal meetings and discussions in addition to the weekly status meeting described below. The following methods may also be utilized to ensure appropriate and timely interchange between the CALIPSO project and science segment software development.

- Teleconferences (weekly, monthly, as needed)
- Monitoring/Reporting (weekly, monthly, as needed)
- Focused Technical Interface Meetings with partners (as needed) and in combination with other reviews when possible
- Reviews
- E-mail
- Documentation: Formal & Informal
- Livelink server for various functions:
    - Document Library
    - Project Status
    - News
    - User's Subprojects
    - Threaded Discussions
- Data Management Team Website
- Project Calendars

Weekly Status Meeting

The CALIPSO software manager will conduct a weekly teleconference with the participation of the science segment manager and software engineers. The purpose of this teleconference is to ensure coordination and timely resolution of issues.

Schedules and Milestones

The science segment manager shall deliver a monthly project schedule to CALIPSO project management.

Progress Metrics

The science segment manager shall deliver a monthly project progress report CALIPSO project management.

Control Boards and Working Groups

As required, various software specific boards and working groups will be formed with affected members of the CALIPSO software and systems community, as well as interfacing organizations. The science segment manager and appropriate software engineers will participate as members of the following CALIPSO project control boards and integrated teams:

- CALIPSO Configuration Control Board (CCCB)
- Mission Integrated Team (MIT)

Documentation Requirements

The science segment will document software products and software engineering activities as identified and described within the science data system SPMP.

Reviews/Audits/Inspections

The science segment will conduct reviews, audits, and inspections as identified and described within the science data system SPMP.

Peer Reviews

The science segment will conduct software peer reviews as identified and described within the science data system SPMP.

Formal Reviews

The science segment will conduct software formal reviews as identified and described within the science data system SPMP.

Integration and Test

The science segment will conduct software integration and test as identified and described within the science data system SPMP.

Acceptance

The science segment will conduct software acceptance as identified and described within the science data system SPMP.

Standards, Practices, and Conventions

The science segment will use the standards, practices, and procedures as identified and described within the science data system SPMP and other applicable engineering documents.

Configuration Management

Configuration Management (CM) of all software artifacts (i.e., documentation, operational software, support software, scripts, procedures, data, etc.) will be the responsibility of the science segment. Software configuration management is described within the science data system SPMP.

Risk Management

The science segment will conduct software risk management as identified and described within the science data system SPMP.

Quality Assurance

The science segment will conduct software quality assurance management as identified and described within the science data system SPMP in accordance with CALIPSO SQA management plan.

APPENDIX A: SOFTWARE METRICS

Required NASA Software Metrics

- Software Characteristics (Section 1.0) are captured in the initial metrics report. (Note: If the data requested is not available at initial submission, complete it at the next monthly reporting period.)
- Software Planning, Tracking, and Oversight Data (Section 2.0) are collected on a monthly basis.
- Operational Reliability data (Section 3.0) are collected monthly after acceptance by NASA.
- Delivery Data (Section 4.0) are collected only once. They are collected when NASA accepts the software.

Metrics Data to be Collected	Project Manager Goals and Questions
1.0 Software Characteristics	
1.1 Project CSCI Identification	G1.1: Classify the project in order to uniquely reference it within the database and generate baseline and comparative project management information.
1.1.1—Project name	
1.1.1.1—CSCI name[1]	
1.1.2—Contact person[2]	
1.1.2.1—Contact person's E-mail	
1.1.2.2—Contact person's Organization	
1.1.3—Start date for this CSCI	
1.1.3.1—Number of planned Spiral/Build Iterations	
1.1.4—Estimated final delivery date for this CSCI	
1.1.4.1—Estimated total source code count[3]	
1.1.4.2—Predominant languages used	
1.1.4.3—Estimated percent of functionality provided by COTS or 1.1.4.4—Estimated percent of software costs allocated to COTS	
1.1.5—Type of CSCI (flight, ground ops, and 3=any other	Q1.1: Are there other projects in the database

[1] When planning multiple releases/deliveries of the same CSCI, treat each delivery separately in Section 2.0 where appropriate based upon development model planned.

[2] Name of person delegated the responsibility for submitting the NASA Software Metrics on a monthly basis for this CSCI.

[3] The count will include software that is to be delivered. The count includes executable statements, and does not include comments, blank lines, or commercial off-the-shelf (COTS) software.

software development item)	that can be used as a basis or guideline to estimate this project?
1.2 CMM Level	G1.2: Identify developer level of processes maturity, performance, and associated level of oversight needed (i.e., additional resources needed for low-CMM-level developers).
1.2.1—Has your organization had a Software Capability Evaluation (SCE) by an SEI certified Lead Assessor? [4] 1.2.1.1—If yes, what was the rating?	Q1.2.1: At what CMM Level is the developer?
1.2.2—Estimated CSCI total software cost[5]	Q1.2.2: What is the total software cost?
1.3 First Month Planning Data	
1.3.1—Software accumulated cost for the first month ($K)	
1.3.2—Software cost plan by month through NASA Acceptance	
1.3.3—Total software staff Equivalent People (EP's) for the first month (civil servant and contractor combined)	
1.3.4—Software staffing EP plan by month through NASA Acceptance	
1.3.5—Identification of software products to be completed in the first month	
1.3.6—Identification of all Software Products to be delivered along with their schedule	
1.4 Authorized person for generating reports	
1.4.1—Software manager's name	
1.4.1.1—Software manager's e-mail	
1.4.1.2—Software manager's Center	
2.0 Software Planning, Tracking, and Oversight Data	
2.1 Software CSCI Management Data	G2.1: Determine project progress against plans in order to: —Understand the accuracy of the original estimates. —Determine whether adequate resources are being applied. —Make course corrections (re-planning decisions) during project development to

[4] If any portion of the software development is contracted out, also complete these items for each contract.

[5] Including the cost of development through acceptance, COTS and government off-the-shelf (GOTS) software, middle-ware, and contractors and/or civil servants costs; but not including, however, the cost of maintenance.

	complete on time and within budget. —Know where to apply reserves. —Determine when to look for factors that are impacting plans. —Look for trends to improve future estimating on this project.
2.1.1—Reporting month[6]	
2.1.2—Fiscal year	
2.1.3—Release	
2.1.3.1—Spiral/Build Iteration Number[7]	
2.1.4—Was a new software schedule baseline established during this reporting period?	
2.1.5—Planned Software Accumulated Cost through the subsequent month (see footnote for 1.2.2) 2.1.5.1—Actual Software Accumulated Cost through the recently completed month (see footnote for 1.2.2)	Q2.1.5: What is the difference between planned and actual cost?
2.1.6.1—Planned Completion date for Software Development Plan[8] 2.1.6.1.1—Actual Completion date for Software Development Plan 2.1.6.2—Planned Completion date for Software Requirements Analysis[9] 2.1.6.2.1—Actual Completion date for Software Requirements Analysis 2.1.6.3—Planned Completion date for Software Architectural Design 2.1.6.3.1—Actual Completion date for Software Architectural Design 2.1.6.4—Planned Completion date for Software Detailed Design 2.1.6.4.1—Actual Completion date for Software Detailed Design 2.1.6.5—Planned Completion date for Software Coding & Testing 2.1.6.5.1—Actual Completion date for Software Coding &	Q2.1.6: What is the difference between the planned and actual schedule?

[6] Specify the fiscal month for which this data is being submitted.

[7] If only one is anticipated, specify 1.If multiple spiral/builds are scheduled, specify the build that this fiscal month's data is being submitted under. If multiple builds are being developed at the same time, then separate reporting sections should be provided for each build

[8] After the initial data is entered, only record the changes from month to month.

[9] Note: the terms used in the following items (i.e. Software Requirements Analysis, Software Architectural Design, Software Detailed Design etc.) are taken from IEEE 12207.0.

Testing 2.1.6.6—Planned Completion date for Software Integration 2.1.6.6.1—Actual Completion date for Software Integration 2.1.6.7—Planned Completion date for Software Qualification Testing 2.1.6.7.1—Actual Completion date for Software Qualification Testing 2.1.6.8—Other Planned Completion date[10] 2.1.6.8.1—Other Actual Completion date	
2.1.7—Total software staff EP's planned for the subsequent month (civil servant and contractor combined) 2.1.7.1—Total software staff EP's actual for the recently completed month (civil servant and contractor combined) 2.1.7.2—Number of unplanned personnel departures in last month	Q2.1.7: What is the difference between planned and actual total staff time?
2.1.8—Identification of planned software products to be completed during the subsequent month[11] 2.1.8.1—Identification of software products completed during the recently completed month	Q2.1.8: What is the actual software production progress against plans?
2.1.9—Current estimate of computer resource utilization at delivery. As appropriate: • RAM • EEPROM • I/O • Communications Links • CPU	
2.2 Software Requirements Management Data	G2.2: Determine software requirements stability in order to: —Determine when resources need to be allocated to solidify requirements. —Determine the growth in requirements. —Determine when to look for factors that are influencing requirements change and/or growth. —Identify when requirements changes are causing cost, schedule, and workforce

[10] Examples may include support of System Integration or System Qualification Testing.

[11] Examples of software products are Software Requirements Description, Software Architecture Description, Software Design Description, Source Code Record (e.g. CSC 1, CSC 2, CSC N), Test Plan, Test Procedures, Test Results Report, User Documentation Description, etc.

	impacts.
Was a new software requirements baseline established during this reporting period?	
2.2.1—Software requirements count[12] at current baseline 2.2.2—Date the current requirements were baselined 2.2.3: Software requirements count at previously entered baseline 2.2.4: Change in total requirements count from previously entered baseline to the current baseline (2.2.1 – 2.2.3)	Q2.2.1: What is the baseline software requirements count? Q2.2.4: How much has the total software requirements count changed since baseline?
2.2.5—Total number of changes to software requirements from the previously entered baseline to the current baseline (Total number of additions, deletions, and modifications.)	Q2.2.5: How many software requirements changes have been accepted from the previously entered baseline to the current baseline?
2.2.6: Percent of change in software requirements (2.2.5/2.2.3 × 100)	Q2.2.6: What is the percent of change in software requirements from the previously entered baseline to the current baseline?
2.2.7—Current requirements count (i.e., end of the month)	Q2.2.7: How much has the total software requirements count changed since baseline?
2.3 Software Testing Data	G2.3: Monitor the number of open and closed Problem Reports (PRs)[13] in order to determine reliability, impacts to schedule, cost, and workforce; and evaluate the likelihood of delivery on time based on the rate at which PRs are being opened and closed.
2.3.1—Total number open PRs 2.3.2—Total number of closed[14] PRs 2.3.3: Total PRs (2.3.1 + 2.3.4)	Q2.3.1: What is the status of the PRs?
3.0 Operational Reliability	
3.1 Operational Reliability	G3.1: Determine software operational reliability.
3.1.1—Total number of confirmed PRs associated with software functionality [15]	Q3.1.1: What is the total number of confirmed software problems that have been reported since delivery?

[12] The software requirements count is the number of unique *shall* statements or other imperatives in the Software Requirements Description for this CSCI. The Automated Requirements Management (ARM) tool is freely available for performing requirements counts at URL http://satc.gsfc.nasa.gov/tools/arm/index.html.

[13] Problem Reports (PRs) as referenced in this text refer to reports for this delivery/release once the software has been delivered for integration testing. Other terms such as *Discrepancy Reports*, or *Failure Reports* are frequently used.

[14] A PR is closed once corrective action is successfully implemented and verified.

4.0 Delivery Data	
4.1 Project Completion Data	G4.1: Determine this project's actuals for use in planning future projects.
4.1.1—Actual final delivery date for this CSCI	Q4.1.1: What is the actual delivery date?
4.1.2—Actual total source code count (see footnote 6)	Q4.1.2: What is the total source code count?
4.1.3: Difference between actual and planned lines of code (4.1.2-1.1.4)	Q4.1.3: What is the difference between actual and planned lines of code at delivery?
4.1.4—Estimated percent of functionality provided by COTS Or 4.1.5—Estimated percent of software costs allocated to COTS	Q4.1.4 What percent of the functions required are being accomplished by COTS?
4.1.6—Date operational	Q4.1.6: What is the date the system went into operation?
5.0 Comments about this project	
5.1—Comments section	G5.1: Provide an explanation concerning any particular metric that was not entered or any item that you feel needs explanation.

Definitions:

Computer Software Configuration Item (CSCI)—an aggregation of software that is designated for configuration management and treated as a single entity in the configuration management process.[IEEE STD 610.12-1990]

Computer Software Component (CSC)—a functionally or logically distinct part of a CSCI; typically an aggregate of two or more software units.[IEEE STD 610.12-1990].

[15] These PRs are reported after delivery. This data is reported as long as the software is being changed during operations. See IEEE 12207.1, clause 6.10 for details on problem reports.

APPENDIX B: ACRONYMS

ACRONYM	DESCRIPTION
3S	Suite du Système SPOT (high-resolution Earth observation satellite)
A/D	Analog/Digital
ABM	Active Boresight Mechanism
ABS	A-Band Spectrometer
AC	Air Conditioning
ACK/NACK	Acknowledge/Non Acknowledge
ACS	Advanced Camera for Surveys
ACWP	Actual Cost of Work Performed
ADC	Analog to Digital Converter
ADEOS	Advanced Earth Observing Satellite
ADM	Angular Distribution Modules
AI	Artificial Intelligence
AIRS	Atmospheric Infrared Sounder
AIT	"Assembly, Integration, and Test"
AMASS	Archival Management Storage Software
AMIP	Atmospheric Model Intercomparison Project
AMSR/E	Advanced Microwave Scanning Radiometer–EOS
AMSU/HSB	Advanced Microwave Sounding Unit/Humidity Sounder Brazil
AN	Analogue
AOCS	Attitude and Orbit Control System
AOD	Aerosol Optical Depth
AOS	Acquisition Of Signal
APD	Avalanche Photodiode
APGS	Automated Production Generation System
APID	Application Packet Identifier
Aqua	EOS-PM
ARM	Atmospheric Radiation Measurements
ASIC	Application-Specified Integrated Circuit
ASTAR	Arctic Study of Tropospheric Aerosol and Radiation
AT	Aliveness Test
ATBD	Algorithm Theoretical Basis Document
ATC	Active Thermal Control
ATM	Asynchronous Transmission Mode

ACRONYM	DESCRIPTION
ATP	Authority To Proceed
ATP	Acceptance Test Procedure
AVHRR	Advanced Very High Resolution Radiometer
AVU	Aircraft Validation Unit
BASD	BATC Aerospace Systems Division
BAT	Band With Allocation Table
BATC	BATC Aerospace & Technologies Corporation
BB	Broadband
BBQ	Barbecue
BC	Bus Controller (MIL STD1553B)
BCWP	Budgeted Cost of Work Performed
BDR	Baseline Design Review
BEOA	Beam Expansion Optics Assembly
BER	Bit Error Rate
BITS	Built-In Test System
BNR	Non Regulated Bus
BOL	Beginning Of Life
BQMS	BATC Quality Management System
BRDF	Bi-directional Reflectance Distribution Function
BVLE	Banc de Validation Logiciel et Electrique (Software and Electrical Validation Bench)
C&C	Command and Control
C&DM	Configuration and Data Management
C&T	Command and Telemetry
C/SSR	Cost/Schedule Status Reporting
CAB	Change Authorization Board
CAD	Computer Aided Design
CADU	Channel Access Data Units
CAGEX/BSRN	CERES /ARM/GEWEX Experiment/ Baseline Surface Radiation Network
CAL	Configured Article List
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations
CAM	Control Account Manager
CAP	Control Account Plan
CASE	Computer-Aided Software Engineering
CBB	Contract Budget Baseline
CBD	Commerce Business Daily
CCB	Configuration Control Board

ACRONYM	DESCRIPTION
CCC	Command Control Center
CCD	Charge Coupled Device
CCSDS	Consultative Committee for Space Data Systems
CDR	Critical Design Review
CDROM	Compact Disk Read Only Memory
CDS	CCSDS Day Segmented Time Code
CE	Conducted Emissions
CENA	Climatologie Etendue des Nuages et des Aerosols
CEPEX	Central Equatorial Pacific Experiment
CERES	Clouds and the Earth's Radiant Energy System
CFA	Cloud Finder Algorithm
CG	Center of Gravity
CI	Configuration Item
CLA	Coupled Loads Analysis
CLCW	Command Link Command Word
CLTU	Command Link Transmission Unit
CM	Configuration Management
Cmd	Command
CMDL	Climate Modeling and Diagnostics Laboratory
CMOL	Configuration Management On-Line
CMP	Configuration Management Plan
CNES	Centre National d'Etudes Spatiales
CoG	Centre of Gravity
CON	CNES Operational Network
COP1	Command Operation Procedure
Co-PI	Co-Principal Investigator
COROT	COnvection and ROTation of the Interior of Stars
COSTAR	Corrective Optics Space Telescope Axial Replacement
COTR	Contracting Officer Technical Representative
COTS	Commercial Off The Shelf
CPU	Central Processing Unit
CRISD	Computer Resources Integrated Support Document
CRM	Continuous Risk Management
CRRES	Combined Release and Radiation Effects Satellite
CS	Conducted Susceptibility
CSC	Computer Software Component

ACRONYM	DESCRIPTION
CSCI	Computer Software Configuration Item
CSM	Center for System Management
CSOM	Computer System Operator's Manual
CSS	Coarse Sun Sensor
CST	Centre Spatial Toulouse
CSU	Colorado State University
CSU	Computer Software Unit
CVCM	Collected Volatile Condensable Material
CWBS	Contract Work Breakdown Structure
DAAC	Distributed Active Archive Center
DAC	Digital-to-Analog Conversion
DAO	Data Assimilation Office
DARPASAT	Defense Advanced Research Projects Agency Satellite
DB	Digital Bilevel
DCMC	Defense Contract Management Command
DCN	Data Communication Network
DDR	Detailed Design Review
DDV	Development Design and Verification
DHU	Data Handling Unit
DIAL	Differential Absorption Lidar
DMA	Direct Memory Access
DoD	Depth of Discharge
DOD	Department of Defense
DP	Data Product
DPAF	Dual Payload Attach Fitting
DPM	Deputy Project Manager
DR	Digital Relay
DRD	Data Requirements Description
DRD	Data Requirements Document
DRL	Data Requirements List
DRS	Digital Relay Status
DS	Digital Serial
DSP	Digital Signal Processor
EAC	Estimate At Completion
EASOE	European Arctic Stratospheric Ozone Experiment
ECLIPS	Experimental Cloud Lidar Pilot Study

ACRONYM	DESCRIPTION
ECMWF	European Centre for Medium-Range Weather Forecasting
ECP	Engineering Change Proposal
ECR	Engineering Change Request
EED	ElectroExplosive Device
EEE	"Electrical, Electronic, And Electromechanical"
EEE	"Electrical, Electronic, and Electromagnetic"
EEPROM	Electrically Erasable Programmable Read Only Memory
EGSE	Electrical Ground Support Equipment
EM	Engineering Model
EM	Electromagnetic
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
Eng	Engineering
EO	Engineering Order
EOL	End Of Life
EOS	Earth Observing System
EOS AM	Earth Observing System Anti Meridian
EOS PM	Earth Observing System Post Meridian
EOSDIS	Earth Observing System Data and Information System
EP	Equivalent Person
ERBE	Earth Radiation Budget Experiment
ESA	European Space Agency
ESD	ElectroStatic Discharge
ESSP	Earth System Science Pathfinder
ESSP AO	Earth System Science Pathfinder Announcement of Opportunity
ESSP PO	Earth System Science Pathfinder Project Office
EUCREX	European Cloud Radiation Experiment
EVS	Earned Value System
FAB	Fabrication
FAR	Federal Acquisition Regulation
FCA	Functional Configuration Audit
FD	Failure Detection
FDIR	Failure Detection Isolation and Recovery
FDTM	Failure Detection TM
FEM	Finite Element Model
FIRE	First ISCCP Regional Experiment

ACRONYM	DESCRIPTION
FM	Flight Model
FMEA	Failure Mode And Effects Analysis
FOV	Field Of View
FPA	Focal Plane Array
FPGA	Field Programmable Gate Array
FQT	Formal Qualification Test
FRR	Flight Readiness Review
FSM	Firmware Support Manual
FSR	Free Spectral Range
FSW	Flight Software
FSWG	Fluxes Science Working Group
FTE	Full Time Equivalent
FTP	File Transfer Protocol
FWHM	Full Width Half Maximum
G&A	General And Administrative
GACP	Global Aerosol Climatology Project
GATS	Gordley and Associates Technical Software
GCM	Global Circulation Model
GD	General Dynamics
GDIS	General Design and Interface Specification
GDS	Ground And Data Systems
GEM	Graphite-Epoxy Motor
Geosat	Navy Geodetic Satellite
GFE	Government Furnished Equipment
GFI	Government Furnished Information
GFO	Geosat Follow-On
GFP	Government Furnished Property
GIDEP	Government And Industry Data Exchange Program
GISS	Goddard Institute for Space Studies
GLAS	Geoscience Laser Altimeter System
GLOBALSTAR	Mobile Phone Communications Satellite
GNSS	Global Navigation Satellite System
GPMC	Goddard Program Management Council
GPS	Global Positioning System
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center

ACRONYM	DESCRIPTION
GYR	Gyrometer
H&S	Health and Status
HBCU	Historically Black College/University
HDF	Hierarchical Data Format
HIRS	High-Resolution Infrared Sounder
HKTM	House Keeping Telemetry
HKTM-P	House Keeping Telemetry Pass
HKTM-R	House Keeping Telemetry Record
HLC	High Level Command
HRDI	High Resolution Doppler Imager
HSB	Humidity Sounder for Brazil
HSSA	High Speed Serial Acquisition
HU	Hampton University
HVPS	High-Voltage Power Supply
HW	Hardware
I&T	Integration And Test
I/F	Interface
I/O	Input/Output
IASI	Infrared Atmospheric Sounding Interferometer
IAT	Instrument Aliveness Test
IAW	In Accordance With
IBR	Integrated Baseline Review
ICC	Instrument Control Computer
ICD	Interface Control Document
ICESat	"Ice, Clouds, and Elevation Satellite"
ICU	Instrument Control Unit
IDD	Interface Design Document
IDL	Interactive Data Language
IDS	Interface Data Sheet
IEEE	Institute of Electrical and Electronic Engineers
IERS	International Earth Rotation Service
IFOV	Instantaneous Field Of View
IFOV	Instrument Field Of View
IGAC	International Global Atmospheric Chemistry
IGRF	International Geomagnetic Reference Field
IHCT	Instrument Health Check Test

ACRONYM	DESCRIPTION
IIR	Imaging Infrared Radiometer
IIRPID	Imaging Infrared Radiometer Payload Interface Document
IIRT	Integrated Independent Review Team
IIS	Instrument Interface Specification
ILR	Integrated Lidar Receiver
ILT	Integrated Lidar Transmitter
INDOEX	Indian Ocean Experiment
INTELSAT	International Telecommunications Satellite
IP	Internet Protocol
IPCC	Intergovernmental Panel on Climate Change
IPSL	Institut Pierre Simon Laplace
IPT	Integrated Product Team
IPVT	Instrument Performance Verification Test
IR	Infrared
IR&D	In-House Research and Development
IRR	Integration Readiness Review
ISAP	International Science Advisory Panel
ISC	Interdisciplinary Science Center at HU
ISCCP	International Satellite Cloud Climatology Project
ISDN	Integrated Services Digital Network
ISM	Infrared Sensor Module
ISO	International Standards Organization
ISWG	Imaging Infrared Radiometer Science Working Group
ITAR	International Traffic and Arms Regulations
ITOC	Instrument Test Operations Console
IUS	Informix Universal Server
JCCC	Jason Command Control Center
JGS	Jason Ground Segment
JMOP	Joint Mission Operations Plan
JOFOC	Justification of Other Than Full and Open Competition
JPL	Jet Propulsion Laboratory
KSC	Kennedy Space Center
KTP	Potassium Titanyl Phosphide
L/V	Launch Vehicle
Landsat	Land Remote-Sensing Satellite
LaRC	Langley Research Center

ACRONYM	DESCRIPTION
LASP	Laboratory for Atmospheric Space Physics (Colorado)
LATIS	LaRC AM-TRMM Information System
LCC	Life Cycle Costs
LCCM	Life Cycle Costs Model
LEANDRE	"Lidar Embarqué pour l'Etudes d'Aerosol, Nuages, Dynamiques, Rayon-nement, et Cycle d'Eau"
LED	Light Emitting Diode
LEO	Low Earth Orbit
LET	Linear Energy Transfer
LEU	Laser Electronics Unit
LISN	Line Impedance Stabilised Number
LITE	Lidar In-space Technology Experiment
LMD	Laboratoire Météorologie Dynamique
LNI	Local Network Interconnection (CNES Intranet)
LOE	Level Of Effort
LogB	Logbook
LOM	Laser Optics Module
LOS	Loss Of Signal
LRD	Launch Readiness Date
LRE	Latest Revised Estimate
LRE	Laser Receiver Electronics
LRR	Launch Readiness Review
LSB	Least Significant Bit
LSWG	Lidar Science Working Group
LTS	Laser Transmitter Subsystem
LTTM	Long Term Telemetry
LW	Longwave
LWCRF	Longwave Cloud Radiative Forcing
LWP	Liquid Water Path
M&P	Materials and Processes
MA	Mission Assurance
MAG	Magnetometer
MAM	Mission Assurance Manager
MAP	Mission Advisory Panel
MBLA	Multi-Beam Laser Altimeter
MC	Mission Centre

ACRONYM	DESCRIPTION
MCDRM	Mission Critical Design Review
MCI	"Mass, Centring & Inertia"
MCR	Main Control Room
MCR	Mission Confirmation Review
MCS	Multi-Channel Scalar
MDR	Mission Design Review
MDRA	Mission Definition And Requirements Agreement
MECH	Mechanical
MECO	Main-Engine Cutoff
METEOSAT	Meteorological Satellite
METOP	METeorological OPerational
MGSE	Mechanical Ground Support Equipment
MICM	Multivariable Instrument Cost Model
MIL-STD	Military - Standard
MIL-STD	Military Standard
MISR	Multi-Angle Imaging Spectroradiometer
MLI	Multi-Layer Insulation
MM	Millimeter
MOC	Mission Operations Center
MOCC	Mission Operations Control Center
MOCD	Mission Operations Concept Document
MODIS	Moderate-Resolution Imaging Spectroradiometer
MOGS	Mission Operations Ground System
MOI	Moment Of Inertia
MOLA	Mars Orbiter Laser Altimeter
MOT	Mission Operations Team
MOU	Memorandum of Understanding
MPM	MicroFrame Project Manager
MRR	Mission Readiness Review
MSB	Most Significant Bit
MSET	CALIPSO Mission and System Engineering Team
MSL	Mean Sea Level
MSP	Mars Surveyor Program
MTB	Magnetotorquer Bar
MTF	Modulation Transfer Function
NA	Not Applicable

ACRONYM	DESCRIPTION
NASA	National Aeronautics and Space Administration
NB	NarrowBand
NCEP	National Center for Environmental Prediction
Nd:YAG	Neodymium: Yttrium Aluminum Garnet
NEdL	Noise Equivalent Radiance Difference
NEPA	National Environmental Protection Agency
NETD	Noise Equivalent Temperature Difference
NEΔL	Noise Equivalent Delta Radiance
NFR	Nonconformance/Failure Report
NFR	Nonconformance/Failures Report
NFS	NASA FAR Supplement
NICMOS	Near Infrared Camera and Multi-Object Spectrometer
NIST	National Institute of Standards and Technology
NMC	NASA mission costs
NOAA	National Ocean
NOM	Normal Operation Mode
NPOESS	National Polar Orbiting Environmental Satellite System
NRC	National Research Council
NSSB	Numerical Software Simulator Bench
O&M	Operations and Maintenance
OAO	Orbiting Astronomical Observatory
OBSW	On Board Software
OBT	On Board Time
OCA	Optical Corporation of America
OCM	Orbit Correction Maneuver
OCM2	Orbit Control Mode 2 Thrusters
OCM4	Orbit Control Mode 4 Thrusters
ODC	Other Direct Costs
OLS	Orbital Launch Services
OMA	Office of Mission Assurance
OMC 2	Orbit Control Mode (2 Thrusters Nominal)
OMC 4	Orbit Control Mode (4 Thrusters Nominal)
OMP	Operations and Manoeuvres Procedures
OOC	Operational Orbit Centre
OPS	Operations
OQ	Operational Qualification

ACRONYM	DESCRIPTION
OS	Operating System
OSEMA	"Office of Safety, Environment, and Mission Assurance"
OVB	Operational Validation Bench
P/F	Platform
P/L	Payload
PA	Product Assurance
PAF	Payload Attach Fitting
PAP	Product Assurance Plan
PARASOL	Polarisation & Anisotropie des Relectances au sommet de l'Atmosphere
PBL	Planetary Boundary Layer
PBS	Polarizing Beam Splitter orPublic Broadcasting System
PBS	Public Broadcasting System
PC	Personal Computer
P-C	PICASSO-CENA
PCA	Physical Configuration Audit
PCB	Printed Circuit Board
PCE	Power Conditioning Equipment
PCE	Payload Controller Electronics
PCES	Payload Controller Emulator System
PDD	Payload Description Document
PDDS	Payload Data Delivery System
PDIS	Payload Design & Interface Specification
PDL	Program Design Language
PDR	Preliminary Design Review
PET	Primary Education Team
PF	Platform
PFM	ProtoFlight Model
PFSW	Payload Flight Software
PGDIS	Payload General Design & Interface Specification
PGDIS	PICASSO-CENA General Design and Interface Specification
PGGS	PROTEUS Generic Ground Segment
PGR	Panel Ground Reference
PHSD	Payload Health & Status Data
PI	Principal Investigator
PICASSO-CENA	Pathfinder Instruments for Cloud and Aerosol Spaceborne Observations-Climatologie Etendue des Nuages et des Aerosols

ACRONYM	DESCRIPTION
PICSER	PICASSO-CENA Systems Engineering Report (now CALIPSO SER)
PIM	Payload Instrument Module
PL	Payload
PLC	Payload Controller
PLTM	Payload Telemetry
PM	Processor Module
PM	Project Manager
PMT	Photo-Multiplier Tube
POCC	Payload Operations Control Center
POLDER	POLarization and Directionality of the Earth's Reflectance
POSW	Payload Operations Software (POCC Workstations)
PPS	Pulse Per Second
PROM	Programmable Read-Only Memory
PROTEUS	"Platforme Réutilisable pour l' Observation, les Télécommunications et Usages Scientifiques (multimission platform for low Earth orbits)"
PSC	Polar Stratospheric Cloud
PSR	Satellite Pre-Ship Readiness Review
PSR	Pre-Ship Review
PSRR	Payload Pre-Ship Readiness Review
PT	Production and Test
PTR	Post Test Review
PVT	Position / Velocity / Time
PWA	Printed Wiring Assemblies
PWBS	Project Work Breakdown Structure
QA	Quality Assurance
QFS	Qualification and Flight Spares
QM	Qualification Model
QPSK	Quadrature Phase Shift Keying
QR	Qualification Review
QSL	Quasi-Static Load
QSP	Quality System Procedure
RAB	Radiation and Aerosols Branch
RAM	Random Access Memory
RDP	Rate Damping Phase
RE	Radiated Emissions
RF	Radio Frequency

ACRONYM	DESCRIPTION
RFA	Request for Action
RH	Relative Humidity
RM	Reconfiguration Module
RM	Remote Monitoring
RME	Relay Mirror Experiment
RMM	Radiometric Math Model
RMS	Root Mean Square
RRL	Risk Reduction Laser
RS	Radiated Susceptibility
RSS	Root Sum Square
RT	Remote Terminal (MIL1553B)
RTM	Requirements Traceability Matrix
RTOS	Real-Time Operating System
RVTM	Requirements Verification and Tracebility Matrix
RWA	Reaction Wheel Assembly
RX	Receiver
S/C	Spacecraft
S'COOL	Students' Cloud Observations On-Line
SA	Solar Array
SADM	Solar Array Drive Mechanism
SAGE	Stratospheric Aerosol and Gas Experiment
SAIC	Science Applications International Corporation
SAM	Stratospheric Aerosol Measurements
SARSAT	Synthetic Aperture Radar Satellite
SAT	Satellite
SBC	Single-Board Computer
SBDL	Standard Balanced Digital Link
SBUV	Solar Backscatter Ultraviolet
SC16	16 bits Serial Command
SCC	Satellite Control Centre
SCCB	Software Configuration Control Board
SCF	Science Computing Facility
SCMP	Software Configuration Management Plan
SCR	Software Change Request
SD	Satellite Dynamics simulator
SDB	System Data Base

ACRONYM	DESCRIPTION
SDB	Small Disadvantaged Businesses
SDD	Software Design Document
SDF	Software Development Folder
SDL	Software Development Library
SDP	Science Data Production
SDP	Software Development Plan
SDR	System Design Review
SDS	Science Data Subsystem
SE	Systems Engineer
SE	Systems Engineering
SEL	Single Event Latchup
SELV-II B	Small Expendable Launch Vehicle (class II B)
SEM	Software Engineering Manual
SER	Systems Engineering Report
SEU	Single Event Upset
SGI	"Silicon Graphics, Incorporated"
SGP	Single Ground Point
SHM	Safe Hold Mode
SI	Système Internationale
SIRN	Solar Irradiance Radiometer
SIRTF	Space Infrared Telescope Facility
SIT	Satellite Integrated Teams
SL	Satellite
SLA	Shuttle Laser Altimeter
SLOC	Software Lines of Code
SMP	Software Management Plan
SMRD	Science and Mission Requirements Document
SMT	Surface Mount Technology
SNR	Signal to Noise Ratio
SOCC	Satellite Operations Control Center
SOGS	Satellite Operations Ground System
SOGS OpQ	Satellite Operations Ground System Operational Qualification
SOGS TQ	Satellite Operations Ground System Test Qualification
SOP	Specialised Operations Plan
SOW	Statement of Work
SPCM	Single Photon Counting Module

ACRONYM	DESCRIPTION
SPF	Software Project File
SPM	Software Projectmer's Manual
SPMC	Single-Photon-Counting Module
SPOT	Satellite Pour l'Observation de la Terre
SPP	Sun Pointing Phase
SQA	Software Quality Assurance
SQAE	Software Quality Assurance Engineer
SQER	Software Quality Evaluation Report
SQPSK	Staggered Quadriphase Shift Keyed
SRD	Segment Requirements Document
SRM	Solid Rocket Motor
SRR	System Requirements Review
SRR	Software Requirements Review
SRS	Software Requirements Specification
SS	Spacecraft Simulator
SSDD	System/Segment Design Document
SSGP	Standard Control Command Ground System
SSM	Second-Surface Material
SSR	Solid State Recorder
SSS	System Segment Specification
SST	Sea Surface Temperature
SSTI	Space Science Technology Initiative
STA	Star Tracker Assembly
STAM	Star Acquisition Mode
STE	Special Test Equipment
STIS	Space Telescope Imaging Spectrograph
STP	Software Test Plan
STPR	Software Test Procedures
STR	Star Tracker
STR	Software Test Report
SUDF	Software Unit Development Folder
SUM	Software User's Manual
SW	Software
SW	Shortwave
SWQA	Software Quality Assurance
TARFOX	Tropospheric Aerosol Radiative Forcing Observational Experiment

ACRONYM	DESCRIPTION
TBC	To Be Confirmed
TBD	To Be Determined
TBR	To Be Reviewed
TBR	To Be Resolved
TBSW	Test Bench Software
TC	Telecommand (Ground command)
TCD	Direct Telecommand (hardware TC)
TC-PL	Tele-Command Payload
TCT	Telecommand time Tagged
TCUH	Telecommand Charge Utile Chargement (Telecommand Payload Software loading)
TCUI	Telecommand charge Utile Immédiat (Telecommand Payload Immediat)
TCUL	Immediate Telecommands
TCUT	Telecommand Charge Utile « time Tagged » (Telecommand Payload Time Tagged)
TEC	Thermo-Electric Cooler
Terra	EOS-AM
THEL	Tactical High-Energy Laser
THR	Thrusters
TIA	Trans-Impedance Amplifier
TID	Total Ionizing Dose
TIM	Technical Interchange Meeting
TLDR	Top Level Design Review
TLM	Telemetry
TM	Telemetry
TMD	Direct Telemetry
TML	Total Mass Loss
TMLCC	Total Mission Life Cycle Cost
TOA	Top Of Atmosphere
TOPEX/Poseidon	Ocean topography experiment
TQ	Technical Qualification
TRMM	Tropical Rainfall Measurement Mission
TRR	Test Readiness Review
TTC	Telemetry Tracking and Command
TTCET	Telemetry and Telecommand Earth Terminal
TX	Transmitter
USN	Universal Space Network
UTC	Universal Time Coordinated

ACRONYM	DESCRIPTION
VAFB	Vandenburg Air Force Base
VC	Virtual Channel
VCA	Virtual Channel Access
VC-HS	"Visibly Clean, Highly Sensitive"
VCL	Vegetation Canopy Lidar
VCM	Virtual Channel Multiplexer
VDD	Version Description Document
VME	Versa Module Europa (Vax Computer Interface)
WBS	Work Breakdown Structure
WFC	Wide Field Camera
WI	Work Instruction
WRS	World Reference System
WWG	Wide Field Camera Working Group
WWW	World Wide Web
WYE	Work Year Equivalent
XBT	X-Band Transmitter
ZVS	Zero Volt Secondaire

APPENDIX C: TERMS AND DEFINITIONS

TERM	DEFINITION
Assemblies	An Assembly is an element comprising a Subsystem. Examples are the telescope, LIDAR receiver and optical bench.
Background	(Lidar) Direct, reflected, and scattered solar radiation detected by the Lidar receiver.
Backscatter	(Lidar) That portion of the transmitted laser light returned to the receiver due to interaction with constituents of the Earth's atmosphere or the Earth's surface.
Band Edge	The wavelength at which the response of an optical filter is half of the peak response; there is a lower and an upper band edge.
Bandpass or Bandwidth	The wavelength interval between the lower and upper band edges (FWHM).
Baseline	(Lidar) The Lidar "signal" measured when laser backscatter and background radiation are prevented from falling on the detector.
Center Wavelength	The wavelength midway between the band edges.
Component	A component is an element comprising an Assembly. Examples are electronics boards, connectors, and optical filters.
CSC	A CSCI is comprised of high-level and low-level components, referred to as CSCs. Software engineers generally maintain an informal development folder at this level. One software engineer is generally assigned ownership of a high level CSC.
CSCI	Each CSCI is entitled to its own tailored set of lifecycle development documentation, based on its inherent complexity to implement.
CSU	A CSC is comprised of software modules or units, coined CSUs. The lowest level of testing occurs at this level, verifying each decision branch (dependent on reliability requirements).
Data Control Network (DCN)	The network that allows the communication between the SOCC, the S-band ground station, and the Internet link (IP protocol) to the MOCC.
Depolarization Ratio	(Lidar) The ratio of perpendicular channel to parallel channel Lidar optical return signals.
Dynamic Range	The maximum measurable variation of a parameter.
FQT	The commonly used abbreviation for Formal Qualification Test. FQT is the formal test of the software to verify the requirements captured in the Software Requirements Specification. The Software Test Plan (STP) identifies the environment in which this testing is performed, as well as the test cases to be developed. A separate software test procedure captures each individual test that satisfies flow-down requirements.
Laser Footprint	(Lidar) The area on the Earth's surface illuminated by a single laser pulse from the Payload altitude. For purposes of this document, the surface of the earth corresponds to local mean sea level, as defined by an Earth geoid model.
Level 0 Data	Raw Payload data at original resolution, time ordered, with duplicate packets and telemetry artifacts removed.
Lidar Science Data	(Lidar) Backscatter profiles.

TERM	DEFINITION
L_{max}	Expected maximum value of combined surface and atmospheric reflected radiance assuming a Lambertian surface (isotropic scatter) with an albedo of 150% and the sun at zenith.
L_{min}	Typical clear-air radiance at deepest absorption line center (isotropic surface with 5% reflectance) for solar zenith of 60 degrees and spectral resolution of 0.5 cm-1 FWHM.
L_{nom}	(ABS) Nominal clear-sky radiance within portions of the oxygen A-band having negligible oxygen absorption.
L_{typ}	Typical clear-air radiance (isotropic surface with 5% reflectance) for solar zenith of 60 degrees.
Mission Operations Control Center (MOCC)	The MOCC performs the mission operations.
Mission Operations Ground System (MOGS)	The MOGS consists of the Mission Operations Control Center (MOCC); the Payload Operations Control Center (POCC); the Payload Data Delivery System (PDDS).
Mission Systems	The collection of elements that must function together to meet the mission objectives. These elements comprise all hardware, software, equipment, facilities, personnel, processes, and procedures that are required to produce this capability.
MOCC	The facility at NASA LaRC responsible for PICASSO-CENA mission operations, including satellite orbit tracking and scheduling science data dump times.
NEdL	Noise-equivalent radiance difference.
Nominal Orbit	The nominal orbit altitude of the PICASSO-CENA satellite is 705 km.
One-Percent Response Point (Upper and Lower)	The wavelength nearest band center at which the response is one percent of the peak response.
Out of Band Response	The ratio of the integrated signal beyond the one-percent response points to the integrated response from the extended bandpass spectral region.
Payload	The integrated instrument suite and other payload subsystems (Lidar, ABS, IIR, WFC, Payload Controller, Solid State Recorder, X-Band Downlink System, and Payload structure). Note+ The star trackers, a spacecraft subsystem, will also be physically mounted on the Payload.
Payload Data Delivery System (PDDS)	The PDDS includes the X-Band ground station, a Level 0 processing and archival system, and the commercial ground network lines required for transmitting the Payload Telemetry Data to the DAAC.
Payload HKTM	Payload parameters that are monitored by the platform via discretes.
Payload Operations Control Center (POCC)	The POCC is the subsystem within the MOCC that monitors the health and status of the Payload and sends commands to the Payload (via the SOCC).
Payload Science Data	The portion of the X-Band Satellite TM composed of the instrument sensor data.
Platform	The spacecraft bus to which the Payload is attached.
Platform Ephemeris & Attitude Data	These data consist of Platform time, position, attitude, and attitude rates. These data are included in the Platform HKTM and are also sent from the Platform to the Payload over the MIL-STD-1553 data link.
Platform HKTM	Platform parameters that are monitored by the platform.

TERM	DEFINITION
PLTM	The Payload engineering data, configuration data, and command status.
POCC	The facility at NASA LaRC responsible for PICASSO-CENA payload operations and health monitoring.
Profile	(Lidar) A sequence of backscatter measurements obtained by sampling the backscatter intensity from a single Lidar pulse as a function of distance from the Lidar receiver.
PROTEUS Platform or Platform	The PROTEUS Platform provides on orbit power, command and telemetry services required to perform the Mission.
Raw Data	Raw Payload data in their original packets as received by the RF ground station.
Repeatability	The allowable difference between successive measurements of the same parameter, or successive occurrence of the same event.
Resolution	The minimum measurable variation in a parameter.
Samples	(ABS) The individual elements of an ABS spectrum; i.e., the measured spectral radiance at a given wavelength in the spectrum.
Samples	(Lidar) The individual elements of a Lidar profile; i.e., the backscatter intensity at a given range from the Lidar.
Satellite	The integrated Platform and Payload.
Satellite HKTM	These data consist of Platform HKTM and the Payload HKTM.
Satellite Operations Control Center (SOCC)	The SOCC will serve as the satellite control center via the S-band telemetry system.
Satellite Operations Ground System (SOGS)	The SOGS consists of the Satellite Operations Control Center (SOCC), the S-Band ground station (TTCET), and the Data Control Network.
S-Band Satellite TM	Consists of the Satellite HKTM and the PLTM.
Science Data	Lidar backscatter data, ABS spectral radiance data, and WFC and IIR image data.
Segment	A system is an element comprising the Segment. Examples are the Launch Vehicle, Platform and Payload Systems.
Shot	(Lidar) A single primary pulse of the Lidar transmitter.
SOCC	The agency responsible for mission operation of the PROTEUS Platform and its S-Band Command and Telemetry interface.
SRS	The software requirements specification captures flow-down requirements that originate in the customer statement of work and derived requirements that support the satisfaction of direct requirements. There is a correspondence between this list of requirements and the final test procedures used in the FQT.
Subsystem	A subsystem is an element comprising a System. Examples are the LIDAR, WFC, ABS, and the IRR Subsystem.
X-Band Satellite TM	Consists of the Payload Science Data, PLTM, and Platform Ephemeris & Attitude Data.

APPENDIX D: SYMBOLS

SYMBOL	DESCRIPTION
L_b	Radiance measured from an opaque cloud
L_i	Measured upward radiance
L_o	Radiance derived from temperature and humidity profiles
e_{sfc}	Surface emissivity
e_c	Cloud emissivity
t_c	Cloud optical depth
t_a	Aerosol optical depth
w	Single scatter albedo
r_{eff}	Effective particle size